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- USSR -

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THE TASKS AND POSSIBILITIES OF MODERN SCIENCE IN OVERCOMING THE ECONOMIC BACKWARDNESS OF CERTAIN COUNTRIES

[Following is a translation of an article by Academician A. N. Nosmeyanov in the Russian-language periodical Vestnik Akademii Nauk SSSR (Bulletin of the Academy of Sciences USSR), Moscow, No. 12, December 1959, Pages 3-15.]

At this meeting, a meeting of scientific workers, it would be quite unnecessary to stress the growing influence of scientific discoveries on the technology and economy of human society. It is the more superfluous since the esteemed Vice-President of the World Federation of Scientific Workers, Professor J. Bernal, has dealt with this question profoundly and admirably in his outstanding work "Science in the History of Society." Nevertheless we must note with pride, on the one hand, the exponential rise in the curve of scientific development and the associated technical progress; and on the other hand we must admit with shame that the most rapid progress has been made in military technology, in the means of destroying man and all that he has created over many generations. The rejection of arms and war, and the peaceful use of the greatest achievements of science and technology would greatly increase the well-being of humanity. The fact is that a considerable proportion of mankind lives under conditions or regular malnutrition and hunger, and the comfort of that portion of our contemporaries scarcely differs from the comfort in which their ancestors lived hundreds and even thousands of years ago. Many serious, painful, and lethal diseases can be liquidated by science; they have disappeared in the highly civilized countries, but they still stalk the earth. All of this occurs at a time when the level of our knowledge could assure life not only for all of existing humanity, but even for a considerably greater earthly population.

With the present power supply humanity is served by mechanical horses to such an extent that in Canada, for example, 8,000 kilowatt-hours per year of power are consumed per person. Grain production in the European countries with intensive agriculture has reached high levels. In Holland and Belgium, for instance, about 38 centners of wheat is harvested per hectare and in the Chinese People's Republic the farmers in individual experimental sections have used new agricultural procedures to harvest 1,152 centners of rice per hectare in 1958, as compared with the 23 centners previously harvested. The artificial mineral fertilizers have now been joined by microfertilizers, the wide

use of which assures markedly increased harvests. Natural fiber has now been joined by large quantities of strong, cheap synthetic and artificial fiber. Fur and leather from animals have been surpassed in all respects by polyamide fur and chlorovinyl leathers. The newest medicines can provide health and strength to millions and millions of humans. The Almost-miraculous means of communication are able to transmit any cultural or artistic achievement to any point on the earth. In the immediate future the power of man to act on nature will increase immeasurably. We can see this in the artificial earth satellites and the artificial planet, the firing of a cosmic rocket to the moon, the construction of atomic-power stations and the work on controlled thermonuclear synthesis, electronic computers, and the wide possibilities in semiconductors. It is shown by successes in the synthesis of high-molecular materials, the advances of physical and chemical methods in the study of basic and elementary life phenomena: metabolism, heredity, and the nature of viruses; and of the higher phenomena of life: the activity of the human brain. That is why we are convinced that the cause of poverty of part of the earth's population lies not in overpopulation, but in the improper use of the technical and economic capacities of man. In order to make proper use of these opportunities to eliminate poverty, hunger, and disease, to raise culture, and to help the underdeveloped countries, it is not necessary to wait future developments in science and engineering. The present state of these arts is quite sufficient.

For my part, as a representative of Soviet scholars at this conference, I should like to point to the example of the Soviet Union; the results which have been achieved by systematic and planned aid from science, engineering, and culture to nations with underdeveloped economies and civilizations, even without using any of the wonders of science.

Of course, in the examples, which I shall present the most important factor was the social one -- the socialist nature of our state system and economy. But the role of science and technology was large. I think a good example would be the socialist republics of Central Asia. The Soviet Union includes five such republics: the Kazakh, Uzbek, Kirgiz, Turkmen, and Tadzhik SSR's. I assign the territorially enormous Kazakh republic to Central Asia with some reservations, since it stretches to the west of Asia. The largest and most populous are the first two, and therefore I shall devote considerable attention to them here.

Actually, of the total population of these five republics, 23,000,000, more than 15,000,000 are in Kazakhstan and Uzbekistan, about equally distributed. Kazakhstan is five times as large as France. Under Tsarism the nations of these Central Asiatic republics were subjected to double exploitation: colonial exploitation by Tsarist Russia and feudal exploitation by the national feudal lords. Therefore before the October Socialist Revolution they were extremely backward, both economically and culturally.

Despite the great natural wealth of industrial raw materials (coal, oil, gas, nonferrous metals, etc), industry was almost nonexistent in Central Asia and Kazakhstan. In this territory, greater than that of all the capitalist countries of Europe together, there were no large

industrial enterprises. There were only small cottage and semi-cottage shops, living mainly by the primary processing of agricultural raw materials.

If in the central regions of prerevolutionary Russia -- which was itself very little industrialized -- there were 48 industrial workers per 1,000 inhabitants, there were only 2 in the Central Asiatic regions of Russia. Industrial production per inhabitant here was, in 1908 prices, one-seventh what it was in the central regions of the country.

Agriculture was based on "wooden" technology, and was very primitive.

One of the oldest nations of Central Asia -- the Kirgiz -- had no concept of the printed word before October.

Literacy among the population of Central Asia and Kazakhstan before October was between 0.5 and 2%.

The health services were also on a very low level. In 1913 there were only 98 hospitals with 1,800 beds and 196 doctors in Kazakhstan. Clinical aid was available only in the cities. The population suffered from plague, cholera, anthrax, leprosy, smallpox, malaria, tuberculosis, and typhus. The death rate was high, particularly among children.

The position of women, which best characterizes the cultural level, was without exception difficult. Women had no rights, and vegetated in a realm of absurd customs and prejudices.

After the October Revolution, as a result of socialist transformations, the life of the nations of the five Central Asiatic republics changed radically. Industry and cities sprang up, agricultural cultivation expanded, and universities, national academies of sciences, and national cadres of scholars, engineers, teachers, and physicians were created. The population began to read. General and obligatory elementary education was introduced and intermediate education became widespread; it will soon become obligatory. National art flowered. Anyone who has lived in the Soviet Central Asiatic republics has seen with his own eyes what enormous successes have been achieved, how the face of these former fringes of Tsarist Russia has changed.

Considering that this economic and cultural building had to start from nothing, from the level of nomadic life, it must be admitted that all this has been accomplished in a very short time. The results of these changes began to be visible at the beginning of the 1930's; they became clearer before the second world war, and particularly in the postwar period. I shall discuss these results in more detail later. Now I should like to dwell on certain problems of the organization of science in the USSR and in the individual union republics, since science and technology have played an enormous role in promoting the economies and cultures of these Central Asiatic republics.

Science in the USSR has followed three roads. The first has been the institutes of higher education, specifically the universities. By the efforts of their professors, lecturers, aspirants, and students in the older courses they conduct scientific investigations at the same

time that they prepare specialist cadres. The second road has been the academic. This includes the Academy of Sciences USSR, the Academy of Agricultural Sciences, the Academy of Medical Sciences, and, finally, the academies of sciences of the union republics. Their creation began in the years immediately after the revolution. The academies conduct planned and free research in basic science and in areas of science connected with the development of the productive forces of the particular regions. The third road is the numerous scientific-research institutes within the economic-state system. They are occupied with planned investigations in applied science within their specialties.

Naturally the development of science and the preparation of cadres of specialists in the Central Asiatic Soviet republics, which will be discussed below, began with the organization of numerous higher educational institutions.

In the very first year after the revolution, in April 1918, the Turkestan National University was opened in Tashkent; later, in 1920, a decree signed by Lenin created the State University. A total of 86 professors and lecturers was sent to Tashkent. An active role in this was played by Moscow University, the oldest in the country.

In 1934 the Kazakh State University was created, and, after the Great Patriotic War, the Tadzhik and Turkmen universities. Along with the universities special educational institutions were developed, which soon trained national cadres in the republics. The network of higher and technical educational institutions developed in close connection with the features of economic development occurring in each republic. In the Uzbek SSR, for example, institutes were created such as the Central Asia Cotton-Irrigation Polytechnic Institute, the Uzbek Agricultural Institute, the Tashkent Agricultural Institute, the Institute of Railroad Economy Engineers, the Finance-Economics and Textiles Institutes, the Central Asia Industrial Institute, and the Tashkent Institute of Engineers of Irrigation and Mechanization of Agriculture.

In the Kazakh republic the Mining and Metallurgical, Agricultural, and Zooveterinary Institutes were set up in Alma-Ata; in Chimkent the Technological Institute; in Karaganda the Mining Institute; in Ust-Kamenogorsk the Road-Construction Institute; and the Agricultural Institute in Akmolinsk.

As early as 1940 there were 30 higher educational institutions in the Uzbek republic, training 19,000 students. In the Kazakh republic there were 20 vuzes with more than 10,000 students.

As industry and agriculture developed scientific-research institutes and laboratories were organized. The study of the productive forces of the country, and its natural wealth was conducted in the first years by the central scientific installations, principally by the Academy of Sciences USSR, and embraced the territory of the union republics.

The first step in this direction was the equipping of complex expeditions to study and exploit natural wealth, to develop economy and culture. The expeditions were headed by outstanding scholars. At the same time young national cadres were working in the republics; these later produced great scholars.

From the initial period date scientific results of their investigations whose economic significance is only now being felt. The expeditions to Central Asia laid the groundwork for prognoses of the presence and nature of useful minerals in the Central Asiatic republics, particularly in Kazakhstan. As a result of subsequent systematic work of geologists (many of whom were from the local national cadres) these deposits were found to be an immense storehouse of natural wealth. Their prognoses led to the discovery of huge reserves of oil and gas in the Turkmen SSR.

Along with studies of natural wealth many biological research expeditions were sent out to exploit the flora and fauna and increase the fertility of the soils of the Central Asiatic republics and Kazakhstan. A valuable contribution was made to the problem of regional parasitology and studies of the natural foci of communicable and parasitic diseases. These investigations played a large role in raising the productivity of animal husbandry and in the struggle against the vectors of a number of parasitic diseases of man and animals.

The methods of complex and stationary study of the dynamics of soil processes have provided data permitting the study of a number of soils and the development of methods of using them in agriculture. The nature of the solonchak and solonets soil-formation process has been discovered; the formation of salty soil, solonchaks, and solods has been explained; and methods have been worked out for the improvement and agricultural cultivation of these soils. Methods have also been proposed for the prevention and treatment of soil salting, and a project for soil improvement and hydrogeological regional classification has been the basis for compiling the plan for rebuilding the irrigation net.

The care which Soviet science showers on the union republics is not limited to studying their natural resources. No less important is the contribution of scholars to the development of culture in the republics of Central Asia and Kazakhstan. The discovery of the ancient Khorezm civilization on the territory of Uzbekistan, of the Parfyan culture in Turkmenia, and of ancient Pyandzhikent in Tadzhikistan have clearly shown the error in traditional historiography, which reduced the history of Central Asiatic culture to provincial variants and ramifications of the "Iranian" and later the "Irano-Arabic" culture. In all the Central Asiatic republics and Kazakhstan the aid and direct participation of scholars from the Academy of Sciences USSR have done much work on the history of these nations and their literatures, from ancient times to the present. Is it necessary to demonstrate the significance of these results for the national consciousness of the nations inhabiting these republics?

It is well-known what an enormous amount of work has been done in our country to create writing systems for those nations of the Soviet Union which had none before the October Socialist Revolution. Writing systems have been developed for 50 languages (Kirgiz, Karakalpak, Abkhaz, Adygey, Chukot, Nanay, etc) and the writing systems reformed

for other languages (Azerbaydzhani, Uzbek, Tadzhik, etc). This has caused the appearance of many national literatures, made possible teaching in the native languages, and has generally contributed to the rapid development of culture in these nations.

As the expedition work of the Academy of Sciences USSR and the preparation of national scientific cadres developed, the requirements were met for organizing, in the national republics, first scientific-research bases, and then complex scientific installations -- affiliates of the Academy of Sciences USSR.

The attention of the bases and affiliates was basically focused on the solution of scientific problems connected with the development of the national economy and culture of each republic. They were interested primarily in studying natural wealth. Later, the affiliates began to work on problems of basic science.

The affiliates of the Academy of Sciences USSR, as one form of local organization of science, have fully proved themselves. In a short time they have prepared the foundations for creating republic academies of sciences in Transcaucasia, Central Asia, and Kazakhstan.

At first the directors of the affiliates were often outstanding representatives of Russian science; then leadership passed to mature national cadres.

In 1941 the academies of sciences of the Georgian and Lithuanian republics were organized; and during the Great Patriotic War the academies of sciences of the Uzbek and Armenian SSRs. Immediately after the end of the war the academies of sciences of the Kazakh and Azerbaydzhan SSRs were created, followed by those of the Latvian and Estonian republics. In 1951 came the academies of sciences of the Tadzhik and Turkmen SSRs, and, in 1954, the Academy of Sciences of the Kirgiz SSR. Thus there are now 13 union republics with their own academies of sciences.

At this stage the role of the Academy of Sciences USSR in the development of science in the republics consists essentially in providing methodological aid in training cadres of scientific workers, in rational division of labor, and in coordinating scientific research.

In order to harmonize research work being performed at the academies of sciences of the union republics, a Council for coordinating scientific activity was established in the Presidium of the Academy of Sciences USSR.

In order to coordinate research on the more important problems scientific councils have been set up which unite scholars and specialists working in a given direction in all scientific installations in the country, regardless of the departmental allegiance or territorial location.

The academies of sciences of the union republics have played an important role in raising the economy and culture of the republics, and also in organizing science locally. In a relatively short time they have been transformed into large scientific centers and have trained their national cadres of scholars. At present the republic academies have 405 academicians, 395 corresponding members, 818

doctors of sciences, and 4,654 candidates of sciences. The cadres of the academies of sciences of the Central Asiatic republics, where there was not one scientific installation before the October Revolution, have grown up very rapidly. Now the academies of sciences of these republics have 105 scientific installations with 113 academicians, 115 corresponding members, 205 doctors of sciences, and 1,143 candidates of sciences.

In the coming seven years 134 new scientific installations will be created in the academies of sciences of the union republics.

In organizing and developing the academies of sciences of the union republics the aim was that they should not duplicate, but rather should supplement, one another. Each academy has its character, its area, its direction in the complex of mathematical sciences, physics, chemistry, biology, etc. We have striven to see that in certain areas, connected primarily with specific productive forces, the academies of sciences of the union republics played a leading role in Soviet science, thus providing the fullest coverage of various portions of each branch of knowledge. At present the coordinating role of the Academy of Sciences USSR might to some extent be shared with the academies of sciences of the union republic.

By way of example I should like to give some details on the activities of the academies of sciences of the Kazakh and Uzbek republics.

The development of the Academy of Sciences of the Kazakh republic is connected basically with the study of oil wells and reserves of useful minerals, the development of local industry, and agriculture.

Kazakhstan now occupies first place in the world with respect to reserves of chromium and vanadium, and first place in the USSR in reserves of iron, copper, lead, zinc, silver, cadmium, wolfram, and numerous other minerals.

It is no accident, therefore, that a strong school of geologists has developed under the direction of the President of the Academy of Sciences Kazakh SSR, K. I. Satpayev. In the geology of Kazakhstan an important position is occupied by a new branch -- metallogeny, which is based on the idea of effective direction of the entire front of geological and prospecting work.

Kazakh geologists have taken the most active part in liquidating the blank spots on the map of Kazakhstan. Investigations within this republic have made it necessary to reexamine earlier views of the geological structure not only of Central and Eastern Kazakhstan, but of the entire western half of the Asiatic portion of the USSR. The geologists of Kazakhstan have raised the question of a radical change in the direction of prospecting for useful minerals in the main metallogenic zones of Kazakhstan, the Tyan'-Shan, and Central Asia. They have compiled prognostic metallogenic maps of Central Kazakhstan and the Altay for the main useful minerals. These maps are now effectively used for prospecting work.

On the basis of the prognostic maps a number of new deposits have been discovered in Central Kazakhstan with ferrous, nonferrous, and rare metals; in addition a reevaluation has been made, sharply increasing

the reserves of many previously known deposits. Of 200 deposits of various metals discovered in the past 4 years in Central Kazakhstan, 90% were found where they were indicated on the prognostic metallogenic maps.

Geology in Kazakhstan has made wide use of new research methods. Geophysical prospecting methods have revealed deposits of oil, coal, and iron, and reserves of high-quality artesian water discovered by drilling wells. In Embinskiy Rayon they have discovered not only petroleum wealth, but the geophysicists have for the first time developed new methods of prospecting for oil-bearing structures using the gravitation variometer, as well as modern methods of seismic prospecting. Metallometric surveying has been used on a wide scale in Kazakhstan. At present aerogeophysical prospecting is being done throughout Kazakhstan; it has helped to discover a large iron-ore base in the Turgay valley and a number of large deposits, and also to show some hitherto unknown features of the structure of the earth's crust within Kazakhstan. In recent years work has begun in Kazakhstan, for the first time in the Soviet Union, on the deep seismic sounding of the thickness of the earth's crust at depths of 30-60 kilometers.

It is well-known that Kazakhstan is extremely short of water. Soviet scholars have done a great deal to eliminate this shortage. Studies of structural-geological and hydrogeological conditions and conditions of formation of various types of ground water have provided prognoses of the artesian basins of Kazakhstan. It has been shown that the total reserve of artesian water together with the ground water in the sand masses is no less than 2 billion cubic meters; this equals the volume of 12 lakes the size of Lake Balkhash. This will make it possible in the near future to bring up large quantities of water to the surface and turn the enormous deserts of the area into flowering oases.

Mining and metallurgy scholars have investigated and introduced highly productive methods of exploiting ore deposits. Scholars of the Academy of Sciences Kazakh SSR have created a new technology of underground ore mining using highly productive automotive equipment. The power engineers and metallurgists of Kazakhstan have developed new methods of smelting copper ores and concentrates.

It should not be thought, however, that all research work here boils down to developing applied and technical sciences. After all, they cannot develop fully without the development of the basic sciences.

In Kazakhstan the basic sciences, particular nuclear physics, are developing well. The activation of large experimental installations of the Institute of Nuclear Physics of the Academy of Sciences Kazakh SSR will create the conditions for expanding the front of investigations in the study of the interaction of high-energy particles with atomic nuclei, which will permit the solution of new problems in the control of nuclear processes in atomic reactors. Kazakhstan now occupies a leading position in the USSR in astronomy. The astrophysicists have successfully completed theoretical investigations of

the structure of the galaxy, the origin of stars, the formation of the planets of the solar system, various problems of cosmogony, the evolution of stars, and basic features of stellar dynamics.

The Academy of Sciences Kazakh SSR is developing the study of new antibiotics against the most widespread dangerous diseases of man, animals, and agricultural plants. Most interesting is the work directed toward seeking antibiotics against cancerous diseases and a number of virus diseases. The microbiologists of Kazakhstan have found an antibiotic, Actinomycin K, which is every effective in treating anthrax, emphysematous carbuncle, and herpes tonsurans. The physiologists of Kazakhstan have developed a method of treating traumatic shock; the antishock fluid which they have developed is now being used in clinics throughout the Soviet Union. The principles of treating brucellosis with antibiotics and combinations of these drugs, which were worked out by medical scholars in Kazakhstan, are being used throughout the country.

My second example is the activity of the Academy of Sciences Uzbek SSR.

Uzbekistan is a land of cotton, the cotton base of the Soviet Union. In 1958 the Uzbek republic produced around 3,000,000 tons of cotton, as against 500,000 tons in 1913. Such a huge rise in cotton production in such a short period was achieved not only by the labor of the peasants, but also with the help of scientific research.

First it was necessary to increase the planting area, and to irrigate hundreds of thousands of hectares of new land. For this purpose the scholars of Uzbekistan, with the help of scholars from the Academy of Sciences USSR, discovered a large quantity of new fertile land and water resources on the territory of the republic. This was used as the basis for building new canals, and reservoirs, and for the agricultural development of new land.

Science played a large role in such matters as raising the fertility of soils, combatting salt and swamps, and developing and introducing a complex of agrotechnical measures.

In order to increase cotton production in Uzbekistan it was necessary to develop new varieties of cotton, giving greater yields, being more stable, and better adapted to mechanization. The selection specialists of Uzbekistan, the biology specialists in agriculture, provided for the development of these varieties. Before the revolution Uzbekistan cultivated local and foreign cotton varieties with low yields and poor technical properties in the fiber. They yielded 10-11 centners per hectare, with low fiber qualities. Now the basic selected varieties developed by the Uzbek selection specialists are of excellent quality and give 30-40 centners per hectare and more. The use of crop rotation, developed by the Uzbek agronomists, increases cotton yields by 30-50%.

Large new factories have been built in Uzbekistan for the production of nitrogenous and phosphorous fertilizers and poisonous chemicals. These plants operate on technological plans developed by scholars

in the republic. It should be noted also that the basis for the creation of new and highly effective insecticides was research done on the chemistry of organophosphorus compounds in the Tatar Autonomous Republic -- in the Kazan' Affiliate, Academy of Sciences USSR.

The central problem in promoting cotton production was, and to some extent remains, mechanization. Great and fruitful efforts have been made by the designers of Uzbekistan in the creation of cotton-picking machines. In the near future cotton production will be completely mechanized.

The efforts of the geologists of the Uzbek republic, of which the President of the Academy of Sciences, Kh. M. Abdullayev, is also a great geologist, have now revealed around Bukhara enormous resources of natural gas. The use of natural gas in the economy will lead to new and still more vigorous development of industry and agriculture, not only in Uzbekistan, but in the other republics of Central Asia as well. Gas will be supplied to the central industrial regions of the Urals and Kazakhstan and will permit still more effective development of the industry of the republics of Central Asia.

The great successes of Uzbekistan and other republics of Central Asia in animal husbandry, silk production, and other branches of the economy would not have been achieved without the aid of science.

The attention of scholars in Uzbekistan has been focused on problems of the complex development of the economy, of the proper combination of branches, location of enterprises, development of complexes, etc. In this connection the republic's scholars have worked out the scientific principles for complex development, specifically long-range plans for the Fergana Valley -- the largest cotton-producing area in the Soviet Union; and the Angren mining and industrial region -- a new center of nonferrous metallurgy, the coal industry, and power. At present a complex plan for developing the basin of the Zeravshan River is being worked out, including such economically important oblasts as Samarkand, Bukhara, and Kashka-Dar'ya.

Theoretical research in physics, chemistry, and biology are also being developed in Uzbekistan. In the near future the Institute of Nuclear Physics, Academy of Sciences Uzbek SSR, will be completed near Tashkent; it will have modern equipment. On 10 September the first atomic reactor in the Soviet East was fired up; soon a cyclotron and other equipment will begin operating. The work of this institute will involve physicists of all the other Central Asiatic academies of sciences.

The Academy of Sciences Uzbek SSR is a center of physico-mathematical research. An original trend in mathematical statistics has developed in Tashkent, the outstanding representatives of which are Uzbek scholars. Closely connected with this work now are investigations being conducted there in computer technology.

The Academy of Sciences Uzbek SSR is an all-union center of alkaloid chemistry, where alkaloid-containing plants are sought and alkaloids studied. So far, out of 4,000 species of wild plants in Uzbekistan, 3,000 have been investigated; of these 800 plants have been found to contain alkaloids. Around 150 new alkaloids have been isolated and their pharmacological properties studied; some of them have found uses in medicine. The republic is also successfully developing investigations into the chemistry of mineral fertilizers, the chemistry of high-molecular compounds, and petroleum chemistry.

All of this work of scholars, engineers, agronomists, and selection specialists, who have appeared out of the national cadres under conditions of the socialist state and the socialist society of nations, played an enormous role in the development of the productive forces of the union republics.

During the years of Soviet power the republics of Central Asia and Kazakhstan have achieved an extraordinary level of development of their productive forces and flowering of their culture. On the basis of science there a modern, highly developed industry has been created in these republics, tens of thousands of factories and plants have been built, great electric power stations erected, and new regions have been created specializing in ferrous metallurgy, the mining of coal, oil, gas, the production of nonferrous metals, the sugar industry, the textile industry, etc.

Here are some concrete facts and data on the vigorous development of the economies of the Central Asiatic republics, connected with the development of science and culture.

The Kazakh SSR is now economically one of the most important republics of the Soviet Union. The total volume of industrial production of this republic in 1958 rose 43 times over the 1913 level, and heavy industry increased 115 times. Reserves of iron ore have increased almost 200 times, and petroleum output has increased 13 times during this period. In 1958 Kazakhstan mined more coal than the entire Russian Empire did in 1913. During the years of Soviet power ferrous metallurgy, the chemical industry, machinebuilding, the production of building materials, and other branches of industry have been created in Kazakhstan. The area sown has reached 28 million hectares: 6 times more than in 1913. There are 252,000 tractors, 93,000 combines, and hundreds of thousands of other agricultural machines working on the fields of Kazakhstan. The share of Kazakh industry in total USSR industry has grown unremittingly. Kazakhstan now holds first place in the country in production of nonferrous and rare metals, third in coal mining, fourth in the rolling of ferrous metals and petroleum mining, and fifth in steel production. In economic development Kazakhstan long ago passed many eastern countries, including Iran, Pakistan, and Turkey.

Kirgizia has become an industrial-agrarian republic with a highly developed metalworking, mining, light, and food industry. Here large quantities of agricultural machines, metalcutting machine tools, equipment for the food industry, saw frames, silk and other fabrics, knitted goods, footwear, and sewn goods are produced. The Kirgiz SSR is outstanding in Central Asia as a large area mining and delivering coal. It occupies a leading position in the USSR in the mining of antimony and mercury.

The leading branches of industry in Turkmenia are petroleum, chemistry, and building materials. In petroleum reserves Turkmenia holds first place among the republics of Central Asia and third place in the Soviet Union. In reserves of natural gas it has second place (after Uzbekistan) and in ozocerite mining it is in first place in the Soviet Union.

Great successes have been achieved in the republics of Central Asia in the development of the power industry. During the Five-Year Plans thermohydroelectric power stations were built, including the Chirchik Cascade (more than 12 hydroelectric stations), the Farkhad GRES, the Angren GRES, the Kuvasay GRES (Uzbekistan), the Kayrak-Kum GES (Tadzhikistan), etc. Since the revolution the output of electric power in the republics of Central Asia has increased almost 1,000 times.

The changes in agriculture have been no less important; on the basis of industrialization of the country and collectivization this has been transformed into a large and highly mechanized operation.

Thus in the Uzbek SSR the area planted to cotton has increased more than 3-fold since 1913. As early as 1957 the Uzbek SSR was the third largest cotton producer in the world (after the USA and China).

The areas planted in the Kazakh SSR have increased 6.7 times since 1913 and now equal 14% of all the area planted in the Soviet Union. In recent years Kazakhstan has become one of the largest Soviet grain-production bases and has sharply increased the area planted to cotton, sunflowers, sugar beets, and other crops. At the same time the Kazakh SSR is a large animal-raising area in the Soviet Union.

During the years of Soviet power the Kirgiz SSR has increased the area planted to all agricultural crops almost two-fold, and that planted to technical crops almost 5 times, while it has become a great sugar-beet center. In yield of sugar beets it is now in first place in the Soviet Union.

In yield of cotton-wool the Tadzhik republic now occupies first place not only in the Soviet Union, but in the world.

The areas planted to cotton in the Turkmen republic have almost doubled since 1913. It has become a large base for the production of fine-staple cotton and silk.

As a result of industrialization and collectivization the republics of Central Asia and Kazakhstan have been transformed into great industrial-agrarian regions. The importance of these republics

in the total economy of the USSR will rise still further during the coming Seven-Year Plan.

Naturally the achievements in industry and agriculture led to a continuous rise in trade turnover, and an increase in the living standard of the population.

As a typical example, the national income in the Uzbek republic increased almost 15-fold between 1937 and 1957. Since around three-fourths of the national income of our country is spent to meet the personal needs of the workers, one can imagine how this was reflected in increased national consumption. This is shown also by the expansion of goods turnover per head of population, equal to 25-fold in comparison with 1927/28.

Economically the population of the republics of Central Asia and Kazakhstan does not differ now from, say, that of Moscow Oblast. The cultural level and living conditions have changed beyond recognition. Not only has illiteracy been completely among the population of the republics of Central Asia and Kazakhstan, but every fourth citizen there studies either in a higher educational institution or in a special intermediate training institution. In the 1958/59 school year 6,227 schools were operating in Uzbekistan with 1,340,000 pupils; in Turkmenistan there were 1,348 schools with around 250,000 children; in Tadzhikistan there were 2,614 schools with 331,000 pupils; in Kirgizia there were 1,752 schools with 322,000 pupils; and 9,432 schools are operating in Kazakhstan in which 1,400,000 children are being taught. General elementary education has now been realized, and intermediate education is being introduced on the basis of polytechnic schools. Every populated place has a school in which teaching is done in the local language.

Particularly great results have been achieved in the USSR in training specialists with higher and intermediate education.

At present there are around 7.5 million specialists in the USSR with higher and intermediate special training; i.e., 39 times more than in Tsarist Russia. In the 767 higher educational institutions of the country more than 2 million students are trained; this is more than twice as many as in all the capitalist countries of Europe taken together. At the same time priority is being given the development of a network of higher educational institutions in the Urals, Siberia, the Far East, Kazakhstan, and Central Asia. If in the eastern regions of prerevolutionary Russia there were four higher educational institutions, now they number 206. The Soviet republics of Central Asia have overtaken a number of foreign countries in numbers of students in higher educational institutions: for each 10,000 of population in Uzbekistan there are 103 students; in Turkmenistan 99; in Kirgizia 64; while for the same population there are 36 students in France; 32 in Italy, 21 in Switzerland, 12 in Turkey, 8 in Pakistan, and only 4 in Iran.

In Uzbekistan there are now 200,000 specialists with higher and intermediate special training: as many as there were in all of Tsarist Russia in 1913. Per 10,000 of population Uzbekistan has 7

times more specialists with higher training than Turkey, and 28 times more than Iran. Tadzhikistan now has 50,000 specialists with higher and intermediate training.

Great success has been achieved in health. In Tadzhikistan, for instance, where the workers could not receive medical aid before the revolution, there are now 56 hospital beds per 10,000 of population. This is twice as many as in Pakistan, 14 times more than in Iran, and 5 times more than in Turkey. In the number of physicians per 10,000 of population Tadzhikistan has overtaken such a highly developed European country as England.

In Uzbekistan there are 9,000 physicians and 800 hospitals; in number of physicians per 10,000 of population this republic has overtaken countries like England, France, and Japan. All of this has led to the liquidation of diseases which were widespread there before the revolution, to a considerable strengthening of health, and an increase in the working capabilities of the population.

As a result of the rise in the wellbeing of the nation and the improvement in health protection in our country the life expectancy of people has increased. The Soviet Union has in recent years had the lowest death rate in the world, and the rise in population is greater than in the great majority of countries. The death rate of the population in the USSR has decreased four-fold in comparison with before the revolution, while mortality of children has dropped six-fold.

One of the outstanding results of the victory of the cultural revolution is the liberation of women in the nations of Central Asia and the rise in their cultural level. There is no area of political, economic, and cultural life there in which women do not participate actively. Hundreds and thousands of women are leaders of production, heroes of labor. Tens of thousands of women are working in education and health. Of 79,000 people working in the health organs of the Uzbek republic, 61,000 are women, and 107 of them have been decorated with the high award of deserving physician of the republic. Hundreds of women are developing Soviet science, technology, and culture. The names of such outstanding scholars as academicians of the republic academies of sciences N. U. Bazanova, Kh. S. Sulaymanova, S. M. Yusupova, and corresponding members of these academies B. D. Kerimzhanova, K. Ryskulova, B. Pal'vanova, and many others are well-known in our country. In past elections in Soviet Uzbekistan alone 14,500 women were elected deputies of local Soviets, 129 deputies of the Supreme Soviet Uzbek SSR, and 16 deputies of the Supreme Soviet USSR.

All of these examples indicate the practical realization of the equality of women with men in all aspects of social life.

There has been a sharp change in the external appearance of the cities of Central Asia. Numerous spacious and pleasant buildings have been built, and lovely parks of culture and rest, squares, theaters, cultural areas, etc., have been developed.

In connection with the construction of numerous factories and plants during the Five-Year Plans in the republics of Central Asia, new socialist cities have sprung up: Almalyk, Begovat, Yangi-Yul', Angren, Leninsk, Chirchik, and Nukus (Uzbekistan); Kok-Yangak, Sulyukta, Tashkumyr (Kirgizia); Sovetabad, Regar, Kirovabad, Shurab, Pyandzhikent, and Isfara (Tadzhikistan); Nebit-Dag (Turkmenia); etc.

There has been a radical change in the appearance of the populations of Central Asia. Here new schools, clubs, children's creches and schools, baths, obstetric houses, medical points, sporting areas, movie theaters, department stores, etc., are being built.

In the kolkhoz villages of Kazakhstan there are around 115,000 clubs, more than 111,000 mass libraries, 61,000 movie installations, tens of thousands of schools, hospitals, and other cultural-housing installations.

The above examples show clearly that modern science and technology are in principle able to raise the productive forces and economies of economically and culturally backward countries in historically short times, to achieve the level of the leading industrial countries and provide for the well-being of the population. The necessary conditions for this are, above all, the rejection of colonial exploitation and general collaboration in raising the economies and cultures of the underdeveloped countries. The international cooperation of scholars must actively contribute to this highly humane task. This will be a shining demonstration of the great mission of science -- to serve the well-being of humanity.

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